Final Report

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New Brunswick Conservation
and Renewable Energy
Demonstration Program

N.B.77

ENERGY FROM MUNICIPAL SOLID WASTE

Fredericton Recycling Inc.

Fredericton, N.B.

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CREDA Project # 2068

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Canada/New Brunswick Conservation and Renewable Energy Demonstration Program

The Conservation and Renewable Energy Demonstration Program Program is administered in New Brunswick by the Energy Secretariat and managed jointly with Energy, Mines and Resources Canada. The Program is designed to help demonstrate promising conservation and renewable energy technologies, to develop public awareness and understanding of these technologies, and to create employment in new or existing industries.

Through over 100 demonstration projects in New Brunswick, a wide variety of conservation and renewable energy technologies have proven to be technically sound and economically attractive. These demonstration projects should now provide a catalyst for commercialization and lead to widespread adoption of many of these proven technologies.

This final report is based on a project which was financially supported by the Energy Demonstration Program. For further information on other demonstration projects funded in New Brunswick under this program, contact:

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Un grand nombre de projets de démonstration se sont avérés à la fois techniquement réalisables et économiquement attrayants.

Le succès ainsi rencontré encourage la commercialisation des procédés les plus accessibles. Cela entraînerait certes l'adoption d'un grand nombre de ces techniques par les propriétaires de domiciles et par l'industrie privée.

Ce rapport final est basé sur un projet qui a reçu une aide financière du Programme de démonstration. Pour de plus amples renseignements, communiquez avec la:

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TABLE OF CONTENTS

	Page
Summary	1
Objective	3
Introduction and Background	3
Description of Demonstration	9
Observations	11
Cost / Benefit Analysis	12
Conclusions	13
Recommendations	25

LIST OF FIGURES

		Page
1.	Residential solid wastes composition for the Atlantic Region (including Fredericton)	6
2.	Fredericton's voluntary curbside recycling program	14
3.	Participation in source separation tends to rise with lengthening programme duration	15
4.	Millions of dollars per year based on 77 tonnes MSW/day	24

LIST OF TABLES

		Page
1.	Material/Commodity Analysis of Solid Waste (Annual) in the Atlantic Provinces	5
2.	Estimated Total Savings from Recycling Based on 77 t/d MSW	7
3.	Secondary Resources Generated Weekly in Fredericton, New Brunswick	8
4.	Estimated Annual Income From Sale of Fredericton's Recyclable Material	17
5.	Cost Comparison of Solid Wastes Disposal Options for Fredericton (1981 $)	21
6.	Potential Revenue from Recyclable Materials	22

Summary

The potential energy displacement of 80% of Fredericton's recyclable stream is shown to be values at $ 2 000 000 annually based on a marginal energy cost of 3 cents/kWh. When all of the municipal solid waste is incinerated the energy would generate a revenue of $500 000 p.a. for the same flow rate.

At current prices, the 80% recovery rate would have a sale value of $1 000 000 and the land-fill operational savings would approach $200 000 per annum.

To the end of 1984, sale of 800 tons of material generated $36 800 in revenue and represented an energy cost avoidance of $49 600. On an average unit cost basis the potential cost of collecting and landfilling this amount would be $30 000.

Without recycling the cheapest method of getting rid of garbage is landfill, the most expensive is an energy from waste plant.

The most attractive option from an energy perspective is source segregation; recycling of high grades; combustion for energy of non-recyclables and wood waste; probably composting of food, animal and yard waste; and landfilling what is left.

The recommended combination is labour intensive and requires a modest capital investment. Furthermore it lends itself to the possibility of value-added industry, taking advantage of our geographical location, and utilizing certain of the secondary material.

Recommendations are made for proper facilities and for feasibility studies on energy generation and industrial ventures.

A community-specific version of this operation should be established in most cities and towns, recognizing the economies of scale.

SOMMAIRE

En faisant le calcul à partir d'un tarif de 3 cents/kWh pour l'énergie, la valeur de l'énergie potentiellement économisée serait de l'ordre de 2,000,000$ par année pour une récupération de 80 % du matériel recyclable à Fredericton. A un même débit, l'énergie produite par l'incinération de déchets solides dans une municipalité résulte en un revenu annuel de 500,000$.

Au prix courant, un taux de récupération de 80 % aurait une valeur de vente de 1,000,000$ et les épargnes dues à l'enfouissement des déchets dans la terre seraient d'environ 200,000$/année.

Jusqu'à la fin de 1984, la vente de 800 tonnes de matériel a représenté un revenu de 36,800$ et une diminution des coûts énergétiques de 49,600$. En se basant sur le coût moyen d'une unité, le coût potentiel pour ramasser et enterrer ce montant de déchets serait de 30,000$.

Si l'on ne considère pas le recyclage, le méthode la moins dispendieuse pour se débarasser des déchets est de les enfouir dans la terre, celle qui est la plus coûteuse est l'énergie produite par les usines de traitement des déchets.

Du point de vue énergétique, l'option la plus attrayante est la sélection à la source; recyclage des matériaux de haute qualité; production d'énergie par la combustion des résidus de bois et des déchets non-recyclables; possibilité d'une compost avec les déchets alimentaires et de jardin ainsi que les matières animales; et enfouir ce qui reste.

Ces recommandations demandent un travail énorme et exigent un investissement en capital modeste. De plus, elles se prêtent bien à la possibilité d'une industrie de valeur ajoutée, en prenant avantage de la localisation géographique et de l'utilisation de certains matériaux secondaires.

On a fait des recommandations concernant une installation adéquate et des études des possibilités pour la production d'énergie et les risques reliés à l'établissement de l'industrie.

Une version communautaire spécifique de cette opération doit être mise en place dans la majorité des cités et des villes, en tenant compte des économies d'échelle.

Objective

The proposal was for the recording and documenting of the performance of the source segregation and recycling program as conducted by Fredericton Recycling Inc. and to support promotion and information transfer to the general public as well as elected and appointed officials.

The prime thrust of the study was to determine the energy impact of secondary resource utilization and to compare this with its value for conversion to energy in an incineration plant.

Further, the study objective was to assess the financial savings to the municipality, the impact on the environment, the potential for employment and the willingness of the people of Fredericton to change their disposal habits.

Introduction and Background

Fredericton Recycling Inc., a non-profit corporation, was established to expand the scope of recycling in Fredericton previously conducted by the Canadian Association for the Mentally Retarded (Fredericton Section).

The objective is to demonstrate the social and economic viability of source segregation and recycling of municipal solid waste as: a diversion from sanitary landfilling; an alternative to incineration; improved

stewardship of local and global resources; an avoidance of energy consumption by displacing virgin materials.

Practically all residential areas of the City are provided with a weekly curbside pick-up of recyclables the weekday before garbage collection. An increasing number of commercial and institutional addresses are being serviced once or more each week.

A 1976-77 study on solid waste composition produced the percentages of various components as shown in Table 1 and Figure 1. The introduction of the 2-litre soft drink container and the recent dramatic switch from tinned steel to aluminum beverage cans has caused changes in the commodity mix since the study date. And there have been other changes. But since change is continuous, the commodity mix in 1985 and in 1990 is unknown. Therefore this report uses the old data because it is the most recent.

It has been estimated that 80% of the recyclable fraction of municipal solid waste could be segregated from garbage. This performance, in the case of Fredericton's waste, would result in an energy avoidance worth two million dollars per year (Table 2). Table 3 is a tabulation of weekly tonnage. An objective of one half of the above would appear attainable.

This is a labour intensive, low technology and low capital investment industry. The key to success is source segregation, the keeping apart of different categories of waste by the generator at the time of discard.

TABLE 1

MATERIAL/COMMODITY ANALYSIS OF SOLID WASTE (ANNUAL)*
IN THE ATLANTIC PROVINCES

Component	As-generated Wet Wt (%)	As-generated Moisture Content (%)	As-received Wet Wt (%)	As-received Moisture Content (%)
Paper	36.98	7.0	42.19	19.66
Kraft Paper	12.11		12.70	13.75
Newsprint	4.39		5.40	23.76
Fine Paper	7.36		7.57	11.03
Other Paper	13.11		16.52	27.15
Glass	9.44	0.0	9.37	0.82
Beer Containers	0.69		0.71	
Reuseable Soft Drink	0.74		0.72	
Non-reuseable Soft Drink	3.41		3.33	
Liquor and Wine	0.88		0.89	
Containers - Food	2.56		2.56	
Containers - Other	0.19		0.19	
Flat and Cullet	0.96		0.97	
Ferrous Metals	7.95	0.0	8.14	2.88
Beer Cans	0.02		0.02	
Soft Can Drinks	1.39		1.41	
Food Cans	2.87		2.91	
Other	3.68		3.80	
Non-Ferrous Metal	0.58	0.0	0.64	10.79
Aluminum	0.52		0.57	
Other	0.06		0.07	
Plastics	5.01	2.0	5.86	14.89
Containers	0.78		0.89	
Sheet Film Other	4.23		4.97	
Ceramics Rubble	3.46	0.0	3.55	4.91
Lumber	4.74	15.0	4.49	12.52
Putrescible	22.44	70.0	16.33	58.12
Textiles Leather Rubber	5.25	4.0	5.42	8.56
Yard Wastes Brush	2.11	50.0	1.68	16.43
Fines	1.61	2.0	1.86	17.78
Petroleum Chemical Mix	0.43		0.43	
TOTAL WEIGHTED MOISTURE CONTENT (%)		20.41		20.85

*From: "Municipal Refuse Statistics for Canadian Communities of Over 100 000 (1976-1977)", Economic and Technical Review Report EPS 3-EC-79-9, Environmental Protection Service, October 1979

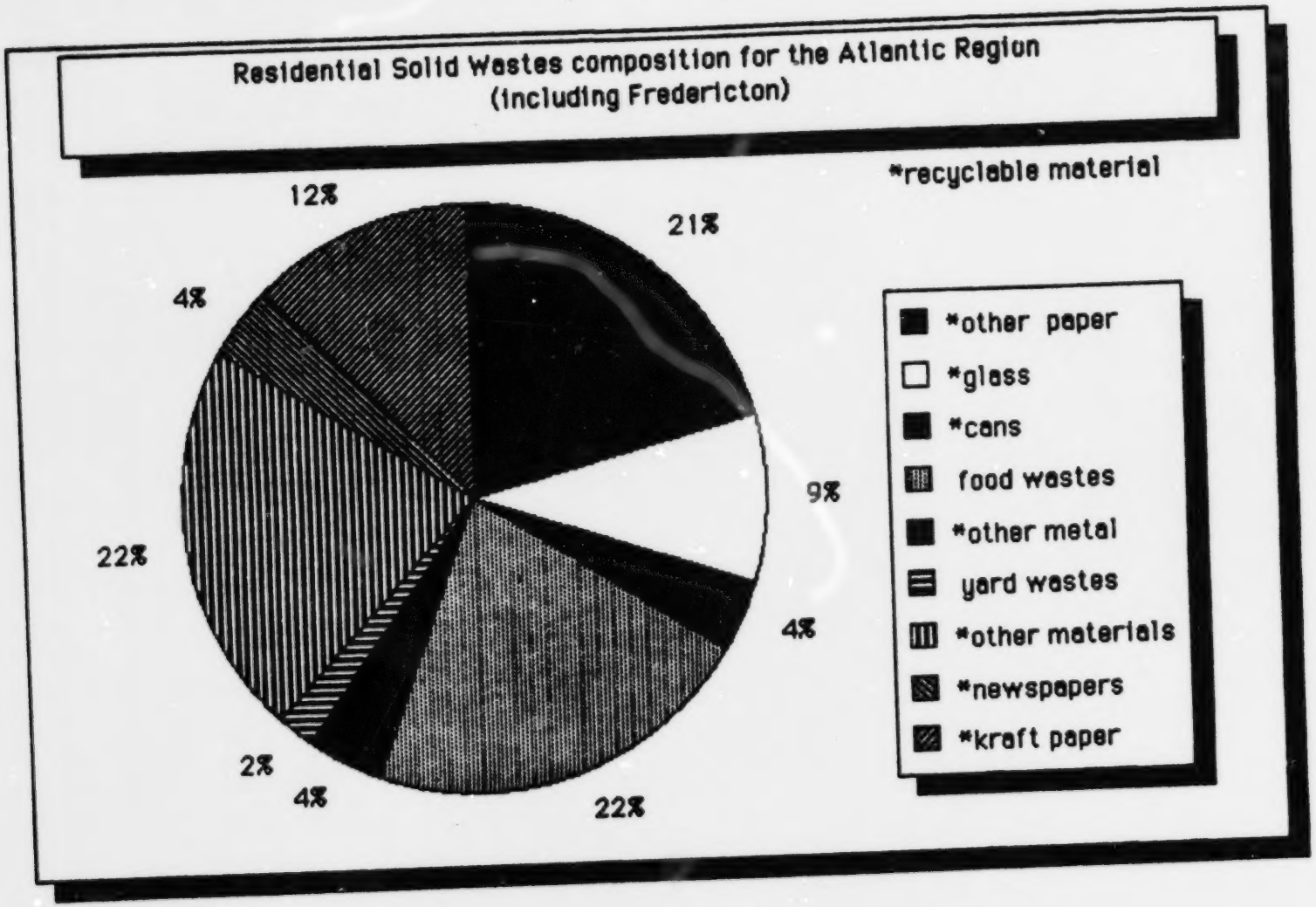


FIGURE ONE

Based on data from "Municipal Refuse Statistics for Canadian Communities of Over 100,000 (1976-1977)"

TABLE 2

ESTIMATED TOTAL SAVINGS FROM RECYCLING
Based on 77 t/d MSW
(80% Recovery of recyclable material)*

1 Material	2 Annual Recovery t	3 Unit Energy Savings kWh/t	4 Energy Value @ 0.03¢/kWh $/t	5 Total Energy Savings kWh x 10^6	6 Savings Per Year $
Kraft Paper	2 720	1 900	57	5.2	155 040
Newsprint	990	2 300	69	2.3	68 310
Fine Paper	1 650	6 100	183	10.0	301 950
Other Paper	2 950	4 900	147	14.5	433 650
Glass	2 120	500	15	1.1	31 800
Ferrous Metal	1 790	4 400	132	7.9	236 280
Aluminum	120	65 800	1914	7.7	229 680
Other Metals	13	19 000	570	0.3	7 410
Plastics	1 120	12 000	360	13.0	403 200
Rubber	280	6 400	192	1.8	53 760
Total	13 753			63.8	$2 000 000

*(Adapted from report by ADI Ltd.)

TABLE 3

SECONDARY RESOURCES GENERATED WEEKLY
IN
FREDERICTON, NEW BRUNSWICK

Material	Tonnes			80%	
Paper					
Kraft	65	200		52	
News	25			20	
Fine	40			32	160
Other	70			56	
Glass					
Returnable	8	51		6.4	
Non-reusable	18			14.4	
Food Containers	14			11.2	41
Other	11			8.8	
Ferrous Metal					
Cans (tinned)	23	43		18	
Other	20			16	34
Non-Ferrous Metal					
Aluminum	2.8	3.1		2.5	
Other	0.3				
Plastics					
Containers	4	27			
Sheet Film	23			22	
			124		
Lumber	25	25		20	
Yard Waste - Brush	18	18		14	

The concept is applicable to any community which is sufficiently concentrated to afford a garbage collection service. Low density population areas could use a drop-off container.

Description of Demonstration

Curbside pick-up includes paper of all kinds (mostly newspapers), bottles and jars, metals including tinned and aluminum cans, and plastic. Commercial pick-ups include the above but consist mostly of office paper, old corrugated containers and glass.

The trucks are of the cube van type with low floors and roll-up loading doors.

Material is rough sorted as it is being unloaded onto sorting tables with a careful inspection as the densification process proceeds. Paper is baled, glass is smashed, cans are flattened, plastics are granulated or baled.

Glass and metals are accumulated in lugger boxes or roll-on/roll-off containers for transport. Paper is warehoused indoors for shipment in trailer load lots.

Most of the processing equipment is owned by the City of Fredericton. The glass smasher and the can flattener were manufactured locally from salvaged parts. The fork lift truck, conveyor belt, plastics granulator and the paper hogger were acquired as used machines. The continuous type paper baler was new and constituted 40% of

the total cost of all equipment listed above. Bins, mobile containers, and sorting tables were constructed locally, mostly of plywood.

Essential elements of the program are marketing and public education, and they go hand in hand.

The public, both in their homes and their workplaces, must be persuaded that the process of source segregation does not entail an excessive amount of extra work and that it is a good thing to do. The process of public education appears to have been very successful, even more than the proponents expected. Public service and paid advertising via the press, radio, television and public transit has had an impact. The GOOD SORT logo and man on the three trucks has provided a billboard which can be seen on every street at least once per week. The official opening of the Good Sort Shop and subsequent open houses have attracted many people.

Purchasers of the product must be persuaded that the material is in the form and quality required by them and that their purchasing policies can be accommodated.

Of paramount importance is the people who are involved. From the manager, the truck driver, the machine operator, the sorter, the swamper, to the lowest performer there is a wide spectrum and the people at the top have an awesome responsibility.

Observations

Fredericton Recycling Inc. began operation with a legacy of the beginning of a comprehensive system from the CAMR and the City of Fredericton. If the present momentum can continue to expand, appreciation must be extended to these two groups. Hindsight is always 20/20.

The initial equipment purchased was a shredder/ hogger and a baler for paper. The City of Fredericton had allocated $35 000 for the combination. On inspection an available used baler proved to be unacceptable junk. The buyers chose a new highly recommended continuous baler of considerable throughput capacity but then had to choose a low-capacity used shredder because of budget limitations.

Alternatively, a mill size down-stroke baler could have been acquired for less and would have been adequate for the start-up volumes. Our current situation is that the low capacity shredder cannot handle the volume of paper in one shift per day nor can it properly shred old corrugated containers. Therefore we are acquiring a used shredder which more nearly matches the capacity of our baler and which will, with additional shifts, handle the total waste paper generation of the Fredericton Region.

The can flattening machine works well but as tonnage increases, the need for a press to form a bale or cube becomes more apparent. Tinned cans, aluminum cans, mixed aluminum, copper and scrap steel all require densification prior to shipment in order to reduce

transportation cost per unit of mass. A used press has just now become available and we are negotiating with the owner.

The glass smasher does an excellent job and probably would handle all foreseen needs with the installation of a hopper feeder and some continuous means of conveying the broken cullett to storage. From this date the purchaser of cullett is paying a premium price for clear glass (flint grade). This will require another sorting operation with additional storage capacity.

Cost / Benefit Analysis

The following sets down the source of operational funds to the end of 1984.

Sales (800 tons)	$36 800
CREDA (Energy Monitoring)	17 900
Environment (Material Diversion)	10 000
Gov't of Canada (Canada Works)	3 300
Loan (privately secured)	12 000

The material sold represented an energy savings of $49 600. This is based on the difference in energy consumption for product manufacture using primary vs. secondary material (Table 2).

The average return on sales was $46.00 per ton. This includes shipping cost in the case of glass and old corrugated but is net for most other materials.

The funds supplied by various levels of government, primarily for monitoring studies amounted to

$39.00 per ton. There was no contribution by the City of Fredericton to operating costs. However 800 tons was diverted from the landfill and most of it was collected by Fredericton Recycling from the generator. The cost of operating the landfill is approximately $10.00 per ton. The cost of curbside garbage collection is close to $30.00 per ton assuming that one-half of the total solid waste is collected under the municipal contract. This represents a potential savings to the municipality of $30 000.

It should also be noted that the municipal landfill cost above does not include the capital cost of the landfill property or the cost of searching for a new site. Whereas building rent paid for the recycling shop was $32.00 per ton based on the volume to the end of 1984.

Hopefully the privately secured loan can be redeemed as volume increases.

In the longer term, as solid waste management is consolidated and rationalized, diversion fees should be considerably less than the cost of alternative means of disposal.

Conclusions

Although the operation has not been a financial success to date the overall evaluation has to be positive. It has been demonstrated that people will cooperate both at home and the workplace in order to establish a more socially acceptable solution to the solid waste problem. An

essential part of multi-material recycling is source segregation. An October 1984 survey, Figure 2, determined that 44.5% of the households were participating. Over 125 commercial/institutional accounts are being serviced weekly or as needed. Participation continues to increase. Figure 3 suggests growth with time.

Information transfer and promotion directed primarily at the general public has resulted in this increased participation and very importantly, has enhanced the support of both bureaucrats and politicians. Where in earlier times one was listened to politely one now recognizes sincere interest.

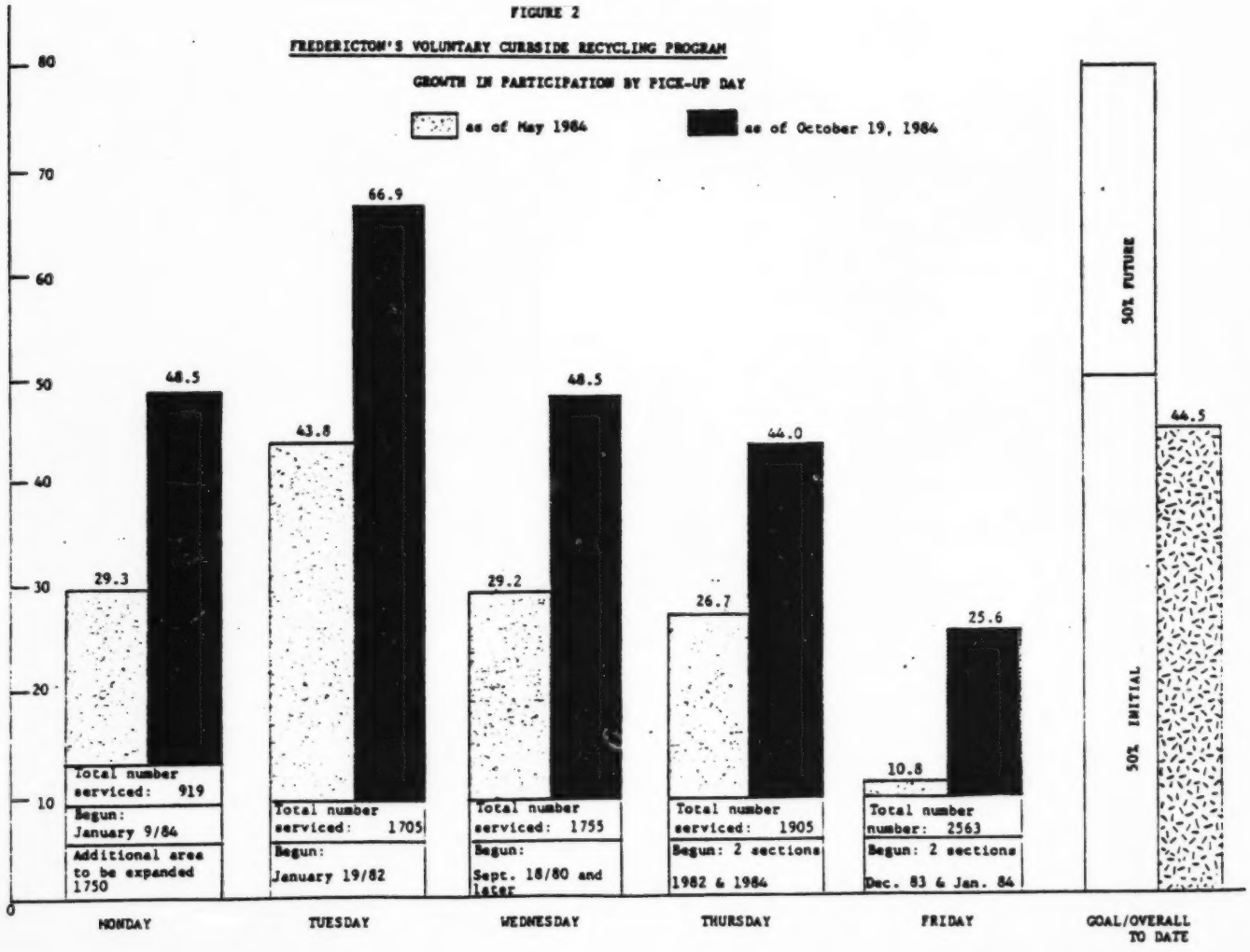
Markets now seem secure. There is a firm demand within New Brunswick for glass and all paper except coated (glossy) stock. Information indicates that considerable tonnage of both brown and white secondary fibre is imported from the USA each day. Metals are all shipped outside of the Province. There is a market for plastics but transportation costs are high, this product is currently being stockpiled.

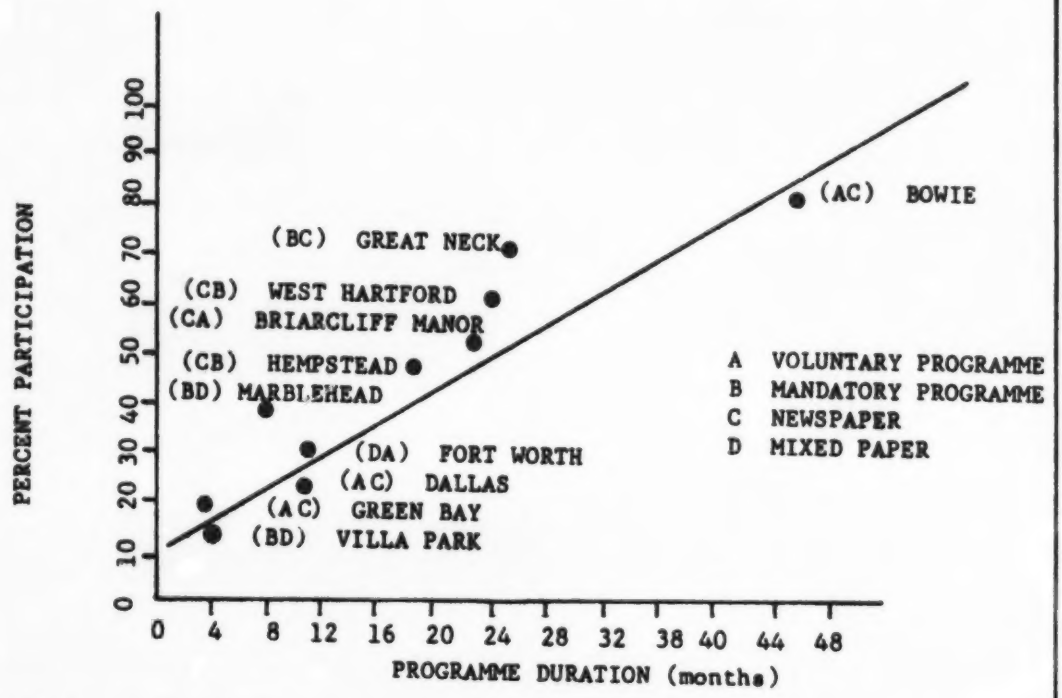
The environmental implications are obvious. In the limit, a sanitary landfill would be unnecessary. As more and more dry material is segregated from the waste stream, the putrescible fraction, food, animal and garden waste, and sewage sludge, can be more readily composted. Although it is very difficult for many people to conceive of a no-waste, conserver society, most would recognize that

FIGURE 2

FREDERICTON'S VOLUNTARY CURBSIDE RECYCLING PROGRAM

GROWTH IN PARTICIPATION BY PICK-UP DAY





SOURCE: SCS ENGINEERS - ANALYSIS OF SOURCE SEPARATE COLLECTION OF RECYCLABLE SOLID WASTE; SEPARATE COLLECTION STUDIES. ENVIRONMENTAL PROTECTION PUBLICATION SW-95c.1:U.S. ENVIRONMENTAL PROTECTION AGENCY, 1974.

FIGURE 3: PARTICIPATION IN SOURCE SEPARATION TENDS TO RISE WITH LENGTHENING PROGRAMME DURATION

land-filling can be substantially reduced and the useful life of such a facility could be extended. Increasing use of secondary resources as a replacement for primary resources reduces air and water pollution, reduces pressure on renewable resources, and extends the life of non-renewables.

There are several opportunities for industrial expansion utilizing the secondary products prepared for recycling, ie: papier mache, instant lawn mulch, plastics processing, de-tinning, bottle washing, rubber mats, in addition to currently existing uses; corrugating medium, cat litter, cellulose insulation, boxboard and higher grade papers, glass bottles. The current demand for material exceeds the supply except for ferrous metals and plastics.

The potential for job creation is difficult to estimate accurately. However a look at the overall possibilities will provide some insight. Table 4 indicates that 80% of Fredericton's recyclables, normally landfilled, would represent an annual income of one million dollars. Since this is a labour intensive operation perhaps 75% would go to wages. Many of the workers would be unskilled. One can see $750 000 supporting 40 jobs or more.

Additionally, initiation of the industrial possibilities mentioned, and no doubt others, would generate many reasonably well-paid jobs. The net income would be vastly increased.

Table 4

Estimated Annual Income From Sale of

Fredericton's Recyclable Material

(80% recovery)

Material	tonnes/year	Current Price/ton FOB F'ton (1985) $	Annual Value $
Kraft	2 720	65	195 000
Newsprint	990	55	60 000
Fine Paper	1 650	135	245 000
Other Paper	2 950	55	178 000
Glass	2 120	30	70 000
Ferrous Cans	936	20	20 000
Other Ferrous	854	20	19 000
Aluminum	120	900	119 000
Plastics	1 120	175	144 000
			1 050 000

1 ton = 2 000 lbs

1 tonne = 2 204 lbs

Perhaps 40% of the food bottles could be washed for reuse, they might be worth 10 times their value as cullett; say $125 000. And perhaps glass beads for reflective paint could be manufactured. The process of detinning of cans appears simple. Tin metal has considerable value and detinned steel is a premium product. Compressing or baling of metal will enhance the value. With cheap heat "irony" or dirty (so-called) aluminum can be upgraded to clean aluminum. Recent introduction of the aluminum can will have a major positive effect on revenue. There are various uses for scrap rubber.

But probably the most exciting secondary industry is the moulding of plastic.

Current markets for post-consumer plastic scrap are in Montreal, Toronto and the USA, and are in the order of five to fifteen cents per pound, delivered. Virgin plastic would cost in the order of fifty cents per pound.

The proposed process requires an oven and large quantities of dry heat, this heat energy could be supplied from non-recyclable combustibles, such as waxed paper and wood. It is estimated that twenty-five tonnes of wood and perhaps twenty-five to fifty tonnes of other non-recyclable combustibles are buried each week in the landfill.

The moulding process is rather simple. An inexpensive mould (there is no pressure involved) is made to the shape of the exterior of the product, it is charged with finely cut plastic, heated in an oven and subsequently

cooled. Refuse containers, composting bins, traffic cones, tote bins and other non-food containers, are particularly suited to this process. Alternatively, drain pipe and/or garden hose could be extruded.

It is important to record here the results of two different studies conducted by A.D.I. Limited, Fredericton, on behalf of the City of Fredericton. The earlier one was for incineration with energy recovery and was based on a catchment area producing 145 tonnes/day. The second study was done in 1981/82 for composting and recycling and was based on a projection of 110 t/d in the year 2001.

Table 5 indicates annual revenue from incineration of $906 000. Table 6 presents the ADI scenario for revenue from recycling. Table 2 indicates annual energy saving by recycling at 80% recovery rate to be $2 000 000 based on 77 t/d generation. When these figures are normalized to equal tonnage one can see that there is four times as much energy to be saved by recycling than can be generated by mass burning.

ie: 2 000 000 x: 906 000 x 77/145

4: 1

This rather simplistic comparison is not wholly fair. Some unknown portion of the "other paper" is not recyclable because of contamination and perhaps it, together with rubber and some plastic, should be incinerated for energy recovery. Also there is energy consumption involved in the recycling process. Perhaps the ratio is nearer to 3:1.

Table 5

Cost Comparison of Solid Wastes

Disposal Options for Fredericton (1981 $)

(110 t/d)

(40 000 t/y)

	OPTION		
	Windrow Composting & Recycling	Landfill only	Incineration* (145 t/d)
Capital Cost			
- total	$2 200 000	$ 320 000	$8 230 000
- per tonne	55	8	158
Gross Annual Costs			
- amortization	395 000	57 000	1 520 500
- total	1 734 000	1 134 000	3 154 300
- per tonne	43	28	60
Annual Revenues			
- total	375 000	-	906 000
- per tonne	9	-	17
Net Annual Costs			
- total	1 359 000	1 134 000	2 248 300
- per tonne	34	28	43

TABLE 6

POTENTIAL REVENUE FROM RECYCLABLE MATERIALS

(80% of Materials Recovered)

Material	Estimated Recovery tonnes/year	Likely Price Range $/tonne 1981	Projected Annual Revenue $
Newsprint	900	45-55	40 500 - 49 500
Metals cans	1 650	0-16	0 - 26 400
Glass	1 900	27-38	51 300 - 72 200
Fine Paper	1 550	55-75	85 200 - 116 000
Kraft Paper	2 550	27-38	68 800 - 96 900
Other Paper	2 800	22-27	61 600 - 75 600
			$307 000 - $437 000

Mass incineration of municipal solid waste is inherently very inefficient primarily because of the proportion of non-combustibles.

Non-combustible	- Water 20%		43%
	- Glass, Metal, etc 23%		
Combustible	- Dry fibre, wood, paper 46%		57%
	- Rubber, plastic 11%		

This mix of materials has a heat energy value approximately one-half that of paper or wood, requires a huge facility to handle the volume, and produces large quantities of ash which must be landfilled. Almost one-half of the gross annual costs and two-thirds of the net annual cost is amortization, a measure of capital intensity. Table 5 also presents revenue comparisons for certain options which include recycling. These are based on a projected mass of 110 tonnes/day in the year 2001. Revenue varies with the assumed recovery rate which is based on the perspective of the report's author and on the level of capital investment for that option. Table 4, based on an 80% recovery rate and current (1985) prices, shows potential revenue of $1 000 000 for a MSW generation rate of 77 tones/day or 30 000 tonnes per year. On average this is $33 per tonne.

Figure 4 graphically illustrates the effect of recycling recovery rate on the comparative economic desirability of various management options. A recovery rate of 20% will save as much energy as incineration with energy

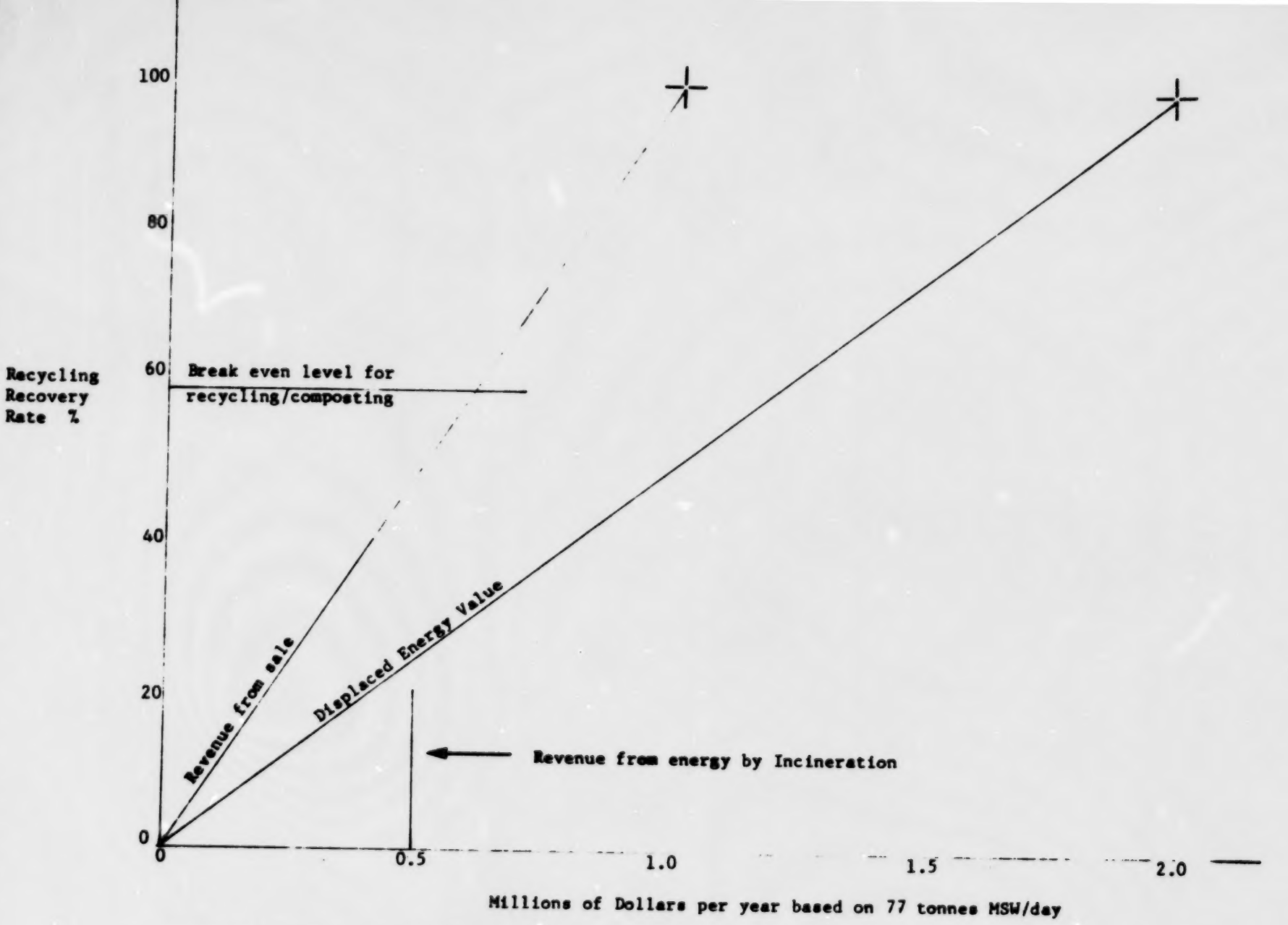


FIGURE 4: Comparison of Waste Management Options

recovery. A 60% rate would reduce the per tonne cost of the windrow composting/recycling option to that of landfill. (Table 5).

Table 4 indicates that 2/3 of the annual value of recyclable material is paper. Fredericton Recycling Inc. is convinced that the value of the non-paper portion can be enhanced by up-grading and by manufacturing. However, waste paper presents the easiest and surest direction for rapid growth of the recovery rate. Newsprint is, for the most part, generated in the home and well over 50% of Fredericton's news is currently being collected. Kraft waste (brown fibre) is mostly generated in retail stores as old corrugated containers. Fine paper (white fibre) is a product of the office, generally, as letter, copy and computer paper, envelopes etc. A large proportion of both kraft and fine paper is currently mixed with garbage and goes directly to the landfill. Municipal land-fill abatement policy could result in maintaining the degree of segregation which initially exists by encouraging the collection of old corrugated containers and of office waste each separately from all other waste. By June 1, 1985, Fredericton Recycling Inc. will have the equipment but not the space to handle all of Fredericton's waste paper and certain cooperative haulers will be delivering to the Good Sort Shop.

Fredericton Recycling Inc. is convinced that a combination of disposal options - recycling, incineration,

composting and landfill - can be implemented which will improve the socio-economic cost/benefit ratio. Increasing participation rates in source segregation and more favourable management policies will improve recovery, enhance efficiency of incineration and landfill, and considerably reduce the capital requirements.

Recommendations

(1) A new and larger facility should be constructed for Fredericton as soon as possible in order to maintain the current growth rate. The present space is inadequate, it lacks user-specific features and the lease expires in August, 1985. $300 000 to $500 000

(2) The heating plant for the new facility should be designed for combustion of paper, wastewood, plastics, rubber and non-recyclable materials. It should be designed to supply process heat as well as space heat for the building. $100 000

(3) A study should be initiated immediately to study the feasibility of certain industrial ventures. Some of the more interesting include:

    (a) Plastic processing
    (b) Non-ferrous upgrading
    (c) Glass bottle washing
    (d) De-tinning of cans

(e) Papier mache and mulch

(f) Re-refining of oil

(g) Rubber tire recycling

If a source separation recycling program appears likely to be initiated in Saint John, Sussex and/or Moncton then a rationalization of overall operations would probably suggest locating one or more in each of Saint John, Sussex, Moncton, Scoudouc and Fredericton.

(4) Fredericton Recycling Inc. proposes to engage the services of an independent consulting engineering firm with experience in energy plants and industrial operations to do a feasibility study on combustion with energy recovery, plastic processing and non-ferrous upgrading.

Further they would conceptualize and do preliminary work on the other ventures mentioned above.

All of this work to be completed within fifteen weeks of approval and for an amount of not more than $23 000. This amount will not be increased without prior written consent by the client.